AN ECONOMIC ANALYSIS OF AN AMERICAN GINSENG GROWING OPERATION IN A WOODLOT IN JANETVILLE, ONTARIO

By

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ABSTRACT

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Keywords: American ginseng, cultivation methods, economic viability, wild-simulated

American ginseng (*Panax quinquefolius*) has been valued for centuries as a medicine, particularly in Asian cultures. It is highly valuable, and as a result it has been poached to endangered levels throughout much of its range. This thesis first reviews the ecology, history, market, cultivation methods and legality of ginseng in Ontario. Second, a business plan for growing and selling ginseng in southern Ontario is presented. This plan shows that American ginseng can be a profitable, long-term crop, and that, when grown as a crop, it can increase the value of private forested land in Ontario versus other crops. Finally, the results of the business plan were compared with a similar study done in New Zealand, where ginseng was grown beneath radiata pine (*Pinus radiata* D.Don.) plantations. The conclusion of this thesis is that American ginseng has excellent potential as a woodlot crop in southern Ontario.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION AND OBJECTIVES

In southern Ontario, farm woodlots have often been used for a large number of objectives, including as a source of firewood, pasture, hunting grounds and lumber. Despite this, forest cover in southern and central Ontario has been decreasing, since the land is more profitable when it is growing annual crops or used as pasture (Schwan et al 2013). One practical way of slowing, stopping and reversing the loss of biodiverse forest cover in southern and central Ontario is to increase the value of the goods and services the land provides, thereby providing an incentive to keep it. (Landowner Resource Centre 1997). One such method may be the production of American ginseng (*Panax quinquefolius* L.) for profit in private woodlots. The objective of this thesis is to develop a business plan for growing ginseng in a woodlot in southern Ontario, and then to evaluate this plan in order to determine whether it is an economically feasible undertaking. I therefore begin this thesis with a review of the fundamentals of cultivating ginseng.

2.0 LITERATURE REVIEW

This literature review is divided into four sections: a) ginseng ecology, history, historic and current demand, and the labour and capital requirements for different cultivation methods.

2.1 ECOLOGY

American ginseng is a shade-obligate perennial herb found in the temperate forests of eastern North America. In Canada it is native to the southern parts of Ontario and Quebec, and is typically found on rich soils, within tolerant hardwood stands dominated by sugar maple (*Acer saccharum* Marshall) (OMNRF 2017). Ginseng prefers a soil pH between 5 and 6, but will grow outside of this range if conditions are right (Mudge et al 2014). It is commonly found in association with wild leek (*Allium tricoccum* Ait.), baneberry (*Actaea pachypoda* Elliot) and blue cohosh (*Caulophyllum thalictroides* (L.) Michaux), which are regarded as indicator plants to identify sites with a high probability of being able to support ginseng populations (Davis and Persons 2014). While it has long been thought that ginseng has highly restrictive habitat requirements, researchers have discovered ginseng occupying a wide range of sites. The frequency of ginseng occurrence diminishes on dry sites, floodplains and sites with a high frequency of conifer in the overstory (McGraw et al 2013). It is suspected that there is a strong correlation between the occurrence of ginseng and sugar maple because of the high calcium levels found in sugar maple leaf litter (Beyfuss 2017). Sugar maples are unable to extract calcium from their leaves before they drop, a trait only shared with

black walnut (*Juglans nigra* L.) and tulip trees *(Liriodendron tulipifera* L.), both of which also host ginseng in their understories (Davis and Persons 2014).

Ginseng is unable to survive in full sunlight, and requires shade levels that are greater than 50% (McGraw et al 2013). Figure 1 below shows current and historic ginseng populations in southern Ontario. Note the small frequency of viable ginseng populations.

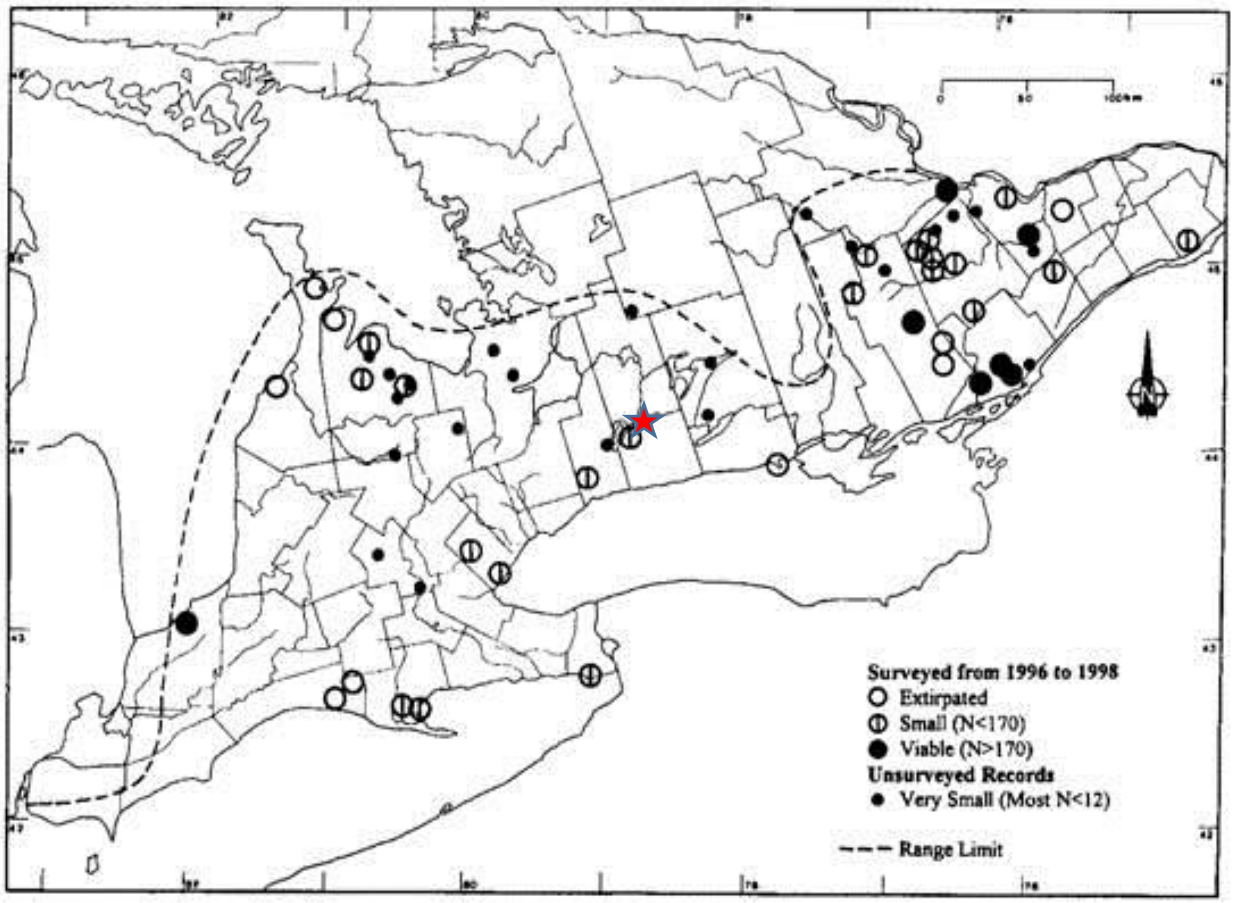

Figure 1: Wild ginseng populations in Ontario from 1996 – 1998 (sararegistry.gc.ca). The red star near the centre of the map is where Janetville is located.

American ginseng produces seeds surrounded by a red-coloured flesh which ripen in August (McGraw et al 2013). The seeds of ginseng must undergo a stratification

period before sprouting, which in this case is a cold period (below 0 degrees Celsius), followed by a warm period and another cold period (Mudge et al 2014). This means a seed produced on a ginseng plant in September that falls to the ground will sprout 18 months later instead of 6 months later, which is the case for many seeds. This is an evolutionary strategy that scientists have hypothesized was developed to deal successfully with unexpected disturbances, for a dormant seed-bank in the soil that can withstand many site disturbances (McGraw et al 2013). Seeds are typically spread by falling to the ground, and researchers have hypothesized that deer browsing of ginseng facilitates the spread of ginseng seeds, as the seedheads are carried small distances by the deer as they eat the leaves but spit out the bitter berries (Beyfuss 2017).

The growth habit of ginseng is determinate. This means that the number of leaves the plant will grow in a year is already determined in the bud properties present from the previous year (Pritts 2010). This determinate property is a common feature in many woodland understory plants, and it leaves them vulnerable to browsing by animals. If a deer eats the leaves from a ginseng plant in July, it will not regrow those leaves that season, but will rather wait until next season (Drohan and Kays 2003). While the root survives the loss of leaves, it results in minimal or no root growth for that ginseng plant during the growing season, which ends up being a loss. Deer populations, whose numbers have more than doubled during the last 3 centuries, represent one of the greatest threats to the ginseng populations in North America (McGraw and Furedi 2005).

Ginseng plants have 4 distinct anatomical features. First, the *root* is the valuable part of the plant, and usually grows slightly every year unless the plant dies or is eaten. Second, the *rhizome* connects the root to the leafy stem, and contains bud scars from where the leafy stem connected to it. Since a new scar forms every year, the age of a ginseng plant can easily and accurately estimated (Mudge et al 2014). Third, a *terminal*

bud forms near the end of the rhizome at the end of every growing season. Finally, the *leaves* consist of bunches of five leaflets, and plants are classified according to how many bunches of these leaflets exist. For example, a two-pronged plant has two *bunches* of five leaflets. Mature plants are typically four-pronged (Pitts 2010). Figure 2 below shows the typical anatomy of an American ginseng plant.

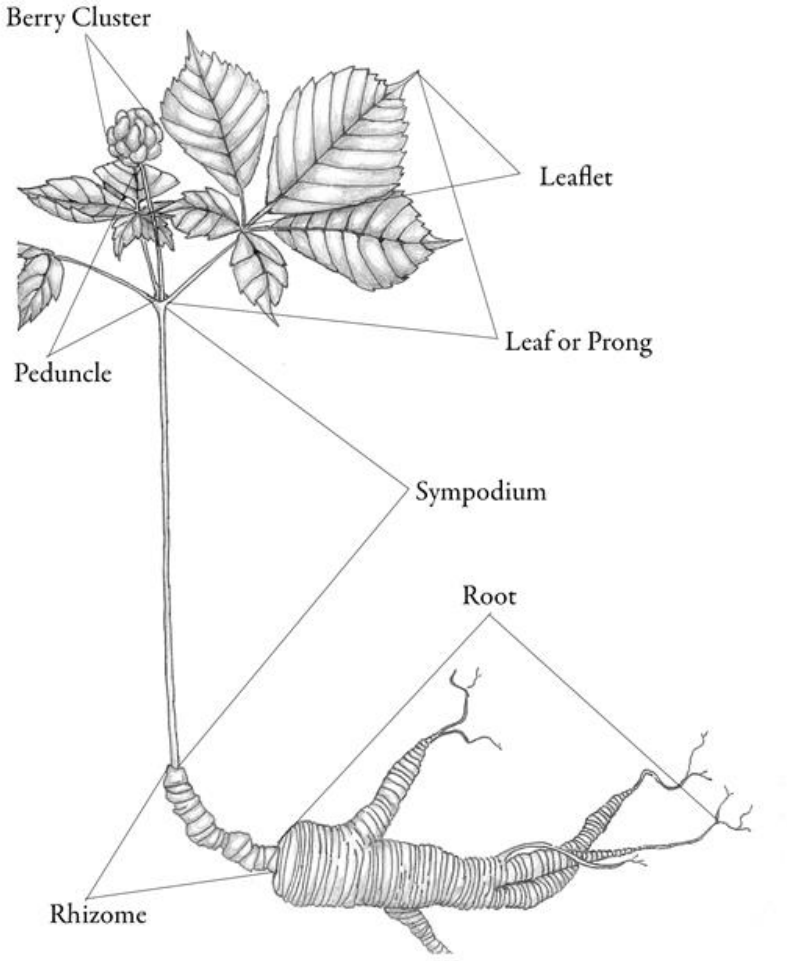

Figure 2: Anatomy of American ginseng showing the root, rhizome, and leaf structure (US Fish and Wildlife Service). Note the rhizome and the presence of the bud scars (strips) across it. This specimen would be 16 years old.

2.2 HISTORIC AND CURRENT DEMAND

Asian ginseng (*Panax ginseng* Baill.) is a species closely related to American ginseng. Asian ginseng naturally occupies the temperate zones of eastern Asia; namely, the Korean peninsula, southeastern Russia, and Manchuria (Davis and Persons 2014). It has been used for thousands of years, particularly by Chinese royalty, who often claimed all ginseng found as tribute for themselves (Pritts 2010). The uses for ginseng have been varied throughout history, but it is nearly always taken to strengthen the immune system and boost mental and physical stamina (Mudge et al 2014). Asian ginseng is said to have more yang characteristics than American ginseng, which means it is more of a stimulant and embodies male energy, or the sun. In contrast, American ginseng is said to have more yin characteristics, meaning it is more cooling, or female, in nature (Davis and Persons 2014). It is worth noting that the Chinese traditionally do not prefer one to the other, but rather seek a balance between the two.

The first European to identify American ginseng as being a close relative of its Asian cousin was a Jesuit priest in the Montreal area in 1716, who recognized the root as being of medicinal value in China (Mudge et al 2014). Once word and some samples had reached China, interest rapidly surged. Enterprising individuals, including the famous American frontiersman Daniel Boone seized upon the opportunity and started exporting the dried roots to China, making him a rich man (Mudge et al 2014). By the late 1700's, the export of American ginseng rivaled and perhaps even exceeded the export of timber and furs from North America (Mudge et al 2014). It became quite apparent in the late 1800's and 1900's that ginseng had become increasingly scarce and, as a consequence, increasingly valuable. This led to an increase in ginseng cultivation under both artificial (shade-cloth) and natural (under a forest canopy) conditions. In fact,

Ontario is now the leading supplier of field-cultivated American ginseng in the world (Liu 2017). Cultivation under a forest canopy is not practiced frequently in Ontario because of bureaucratic hurdles, but it fetches prices that can be over 10 times what is paid for field cultivated ginseng. Demand for wild or wild-simulated ginseng remains very high, and has even been called 'a bottomless market' (Drohan and Kays 2003).

Since the discovery of American ginseng, it has been in very high demand, particularly in Asian markets as a medicinal root. This demand has been so high that American ginseng is endangered in many parts throughout its range, and has become rare (OMNR 2017). Consumption of ginseng in China is rising with incomes, particularly after the Chinese central government formally approved ginseng for use in medicines (Davis and Persons 2014). Traditionally, Hong Kong and Taiwan have been the major markets for ginseng, with annual consumption averaging over 60 grams/person, and mainland Chinese only consuming 2 grams/person annually (Davis and Persons 2014). This is changing rapidly as mainland China becomes increasingly wealth and hosts many more wealthy individuals. While Ontario does grow the largest amount of field-cultivated American ginseng in the world, this product does not satisfy the demand for wild or wild-looking ginseng roots, which often have 10 – 20 times the value on the open market because of higher perceived quality (Attalah 2017).

While wild-simulated ginseng does have somewhat higher ginsenoid (the active medical ingredient) content, the price is disproportionately higher (OMAFRA 2015). This is because ginseng is graded exclusively on its appearance and origin, and not on its chemical composition. An exception to the rule would be pharmaceutical companies who are interested in extracting specific compounds from ginseng (Davis and Persons 2014). Prices for wild and wild-simulated ginseng have been rising at or above the rate of inflation. In 1982, prices for wild ginseng ranged from $133 – $152 per pound, while

the most recent statistics for 2012 show prices at $400 – $1250 per pound (Davis and Persons 2014). Field cultivated ginseng has stayed at a steady price, with maximum prices in 1982 at $51 and $42 in 2012.

There may also be domestic demand for wild-simulated American ginseng, especially in the substantial Chinese immigrant community in the Greater Toronto Area. Prior to outlawing the collection of wild ginseng from Crown forests in Ontario, wild American ginseng roots were occasionally found in Toronto's Chinatown for upwards of $1000/pound (S&W 1997). There is a growing market for ginseng amongst health-conscience Canadians who are not of Chinese origin (Hoag 2015). Wild American ginseng populations are very rare and protected in Ontario, and poaching is still an issue, despite the heavy fines and jail-time associated with such offenses (OMNR 2017).

The wild-simulated ginseng market, according to numerous sources from the United States, can be filled with challenges, such as fraudulent dealers, but the general consensus is that once a grower has established a good reputation with one or more dealers, very little marketing is required (Persons 1994, Beyfuss 2017, Pritts 2010).

2.3 CULTIVATION METHODS

The cultivation of American ginseng is broadly categorized into three different types. This literature review will describe the field cultivated, woods cultivated and wild simulated methods and evaluate their various merits.

Field cultivation of ginseng occurs by tilling the soil in an open field, establishing a system of raised beds, and installing a shade cloth or lathe system to protect the ginseng from full sun (OMAFRA 2015). It generally takes 3 to 4 years to

grow the ginseng to maturity and yields can be up to 2000 pounds per acre in each rotation. The roots are shaped like carrots because the friable, tilled soil does not encourage strange root shapes, and gets downgraded as a result (Persons 1994). The ginseng is also grown in such high densities that diseases can become a significant problem. In fact, the provincial ginseng specialist, Sean Westerveld, freely admits that ginseng cannot be grown without the use of pesticides. Field cultivation of ginseng also suffers from a poorly understood phenomenon called replant disease, which prevents ginseng growers from replanting the same fields with ginseng for up to 50 years after the harvest date (OMAFRA 2015). This hampers farmers in the ginseng belt of Ontario, who must now lease or buy land in an ever expanding radius from the farm. In fact, ginseng farmers in Ontario regularly commute up to 40 minutes from their farmhouses to their ginseng gardens (Arnason 2018). Field cultivation requires much upfront capital, including machinery for tilling, spraying, mechanical harvesters and shade cloth. Statistics from Cornell University suggest that at least $65 000 worth of capital is needed per acre to plant, tend and harvest one acre of field-cultivated ginseng to maturity (Beyfuss 2015). Labour is also required on a weekly basis during the growing season.

Woods-cultivated ginseng has many similarities to field cultivated ginseng, except instead of using shade cloth, a tree canopy is used (Pritts 2010). Removal of shallow tree roots and tilling occurs prior to seeding, which results in high levels of disturbance on the forest floor (Davis and Persons 2014). Since the environment is slightly less controlled, yields are also lower, with 600 – 800 pounds per acre being normal. The rotation age is also longer: 6 – 7 years instead of 3 – 4 (Atallah 2017, Davis and Persons 2014). While replant disease is still an issue in woods cultivated ginseng, it appears to be less severe (Davis and Persons 2014). The roots are also grown in tilled soil and have a carrot-like appearance, and they demand much higher prices than field

cultivated ginseng because the slower growth results in more concentric rings on the root, which is desired by consumers, but sell at a discount to wild or wild-simulated ginseng (Pritts 2010). Woods-cultivation still requires high amounts of capital, namely a tractor and rototiller for tilling the soil. Nevertheless, it is less expensive than field cultivation because shade cloth is not required (Beyfuss 2015). W. Scott Persons, who has done extensive labour studies on growing ginseng says just under 2000 hours of labour are required per acre during 1 rotation of woods cultivated ginseng.

Wild-simulated ginseng attempts to grow ginseng to make the roots look wild, which results in the highest possible prices. Wild – simulated ginseng involves selecting ideal sites in a woodlot, raking off the leaf litter in the fall, spreading seeds, and replacing the leaf litter (R.I. Department of Environment n.d.). Plants are left to 'fend for themselves' for nearly a decade, with rotation ages ranging from 7 – 10 years (Beyfuss 2017). Yields of between 100 – 600 lbs per acre are common. The wide range of yield exists because of the highly variable qualities of soil within a natural forest (Persons 1994). Replant disease is not common in wild-simulated plantings because of the much lower planting densities associated with this method. Since the soil is not tilled, roots grow slowly and gain a gnarly appearance with time (Pritts 2010). Capital required for wild – simulated plantings is minimal, with only hand tools and seeds needed. Labour is also lower, at just over 1100 hours required per acre over the course of a 9-year rotation (Persons 1994). Figures 3 and 4 below show a wild ginseng root and field cultivated roots. Note the concentric rings present on the wild root compared to the lack thereof on the cultivated root. The lengthy rhizome present on the wild root also adds value. In contrast, the cultivated roots have a very short rhizome because they are only 3 to 4

years old.

Figure 3: Wild ginseng root and rhizome (American Ginseng Pharm).

Figure 4: Field cultivated roots (Sea of Chi).

Labour statistics are not common for wild-simulated ginseng, and only three sources were found that had reliable data (Mudge et al 2014, Davis and Persons 2014, Atallah 2014). The statistics provided by Davis and Persons in their book called Growing and Marketing Ginseng, Goldenseal and other Woodland Medicinals were used in this thesis since they were more thorough and conservative.

2.4 LEGALITY

Ginseng is considered an endangered species under both the provincial *Endangered Species Act 2008* and the federal *Species At Risk Act 2002* (OMNRF 2017). Since Canada is also a signatory nation to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), it must abide by certain rules when exporting or importing ginseng.

The *Species At Risk Act* only applies to federal lands, migratory birds and fish, and is therefore of no concern to American ginseng on private land. The *Endangered Species Act* (ESA) of Ontario applies to wild American ginseng on both public and private lands. Currently, field cultivated American ginseng is permitted under the *ESA* provided that growers pay mandatory fees to the Ontario Ginseng Growers Association (ESA 2007). The ESA states, in Section 12 of O. Reg. 242/08, clause 9 that the cultivation of endangered vascular plants is legal provided that the person is not engaged in cultivating the species in the wild in Ontario. The ESA does not define 'wild', so it is unclear whether a sugarbush (taxed as agricultural land and considered a farm) is wild or not. The Ontario Ministry of Natural Resources and Forestry (OMNRF) confirms this on a case by case basis on the district level. In order to guarantee legality, an overall benefit permit can be applied for at the district level OMNRF office. In order for the application to succeed, the applicant must prove that the proposed action will have a positive benefit on the species over the long term (OMNRF 2018). Bob Beyfuss, an extension officer from New York, believes that the production of wild-simulated ginseng can reduce demand for wild ginseng, thereby assisting the species (pers. Comm., January 12, 2018). This is because wild and wild-simulated ginseng are virtually identical products and

fulfill the same market niche, whereas field cultivated ginseng is seen as inferior to and not a replacement, of wild ginseng (Davis and Persons 2014).

3.0 DATA COLLECTION

3.1 PURPOSE

This study is looking at the economic viability of growing wild-simulated ginseng in a sugarbush in southern Ontario. A business model is created to simulate the costs and benefits of producing ginseng over a 25 year period to determine the breakeven price, the net present value, the internal rate of return and to do a sensitivity analysis. The potential risks associated with growing ginseng such as poaching, deer and disease will be explored, as well as the marketability of the product.

3.2 LOCATION OF STUDY

The location of this case study is in Janetville, Ontario on a 200-acre farm. Of this 200 acres, 9 acres consists of sugarbush in the southern portion of the Great Lakes – St. Lawrence forest, which is suitable for growing ginseng. Figure 1 on p. 3 shows the approximate location of Janetville in southern Ontario. It lies in Plant Hardiness Zone 5b, which is suitable for growing ginseng, and consists mainly of fine sandy loams. Loams are desirable for growing ginseng, as they are well drained, but do not drain so fast as to be prone to drought. Species such as wild leek, baneberry and blue cohosh are found throughout the woodlot, indicating that it is a suitable site for growing ginseng.

3.3 DATA COLLECTED

The data used for this study was obtained by using actual farm costs (property taxes, insurance, utilities, Ontario Ginseng Growers Association fees), historic and current ginseng prices, and by reviewing literature on ginseng yields and labour requirements. Ginseng prices for wild and wild-simulated ginseng have not been available in Canada since 2007, therefore, data from the United States were used. Ginseng trades on the open market, so prices are similar throughout North America at any given time (Persons 1994).

4.0 METHODS

In order to make a business model, certain assumptions were made based on the literature reviewed, known costs, and limitations. Table 1 below presents the assumed parameters made underlying this business model. Unless values were precisely known (taxes) or were easy to research (cost of chainsaw), the more conservative parameters were obtained from the literature (Mudge et al 2014, Davis and Persons 2014, Atallah 2014).

Table 1. Assumed parameters underlying the business model in this thesis.

Assumption	Value
Yield (lbs/acre/rotation)	150
Plantable area (acres)	9
Price/lbs of dried ginseng roots ($)	300
Labour ($/hour)	20
Planting (hours/acre)	75
Maintenance and troubleshooting (hours/acre/year)	50
Harvesting, washing and drying (hours/acre)	700
Seed collection and stratification (hours/acre)	80
Marketing, transport and sales (hours/acre)	50
Materials cost for the drying kiln (including taxes) ($)	793.94
Labour cost for the drying kiln ($)	200
Materials cost for the deer fence (including taxes) ($)	3059.06
Labour cost for the deer fence ($)	3220
Equipment cost (chainsaw, spades, racks, wheelbarrow) ($)	969.42
Property taxes (farm portion) ($/year)	589
Farm insurance ($/year)	502
Utilities ($/year)	2400
Ontario Ginseng Growers Association fee ($/acre/year)	100
Banking fees ($/year)	98
Discount rate (%/year)	6
Seed cost ($/acre)	2160

It was assumed that 1 acre would be planted per year until all the land area (9 acres) had been planted, which would occur in year 9, at which point, the acre planted in year 1 would be harvested and replanted. The objective is to generate an even flow of ginseng from the property in perpetuity. Yields were calculated at 150 lbs/acre, which is on the lower end. Labour was calculated at $20/hour, which is just slightly above the minimum wage plus fringe benefits (employer CPP, EI, WSIB premiums). Note that nearly all labour associated with ginseng would take place during the months of August to November, which would not interfere with the maple syrup operation already occurring there. The costs for constructing a small drying kiln (5' by 5') were included. This building would look quite similar to what tobacco growers historically used. This model also assumes that a 700 m, 7-foot-high deer fence is constructed. It is currently unclear whether this would be required, but it was decided to err on the side of caution and construct one anyways. Further details related to the deer fence and drying kiln are presented in the Appendix.

A cash flow model was then built and analyzed to determine the required breakeven price of ginseng at 15 years and at 25 years. The internal rate of return, net present value, benefit-cost ratio and profit were also calculated at 15 years and at 25 years, using the assumptions presented in Table 1. Finally, a sensitivity analysis was done to determine how sensitive this business model is to discount rates.

5.0 RESULTS

In this section, the results of the business model will be presented. A breakeven analysis, the internal rate of return, net present value, benefit – cost ratio, profit and a sensitivity analysis will be presented. The cash flow projections were calculated for 25 years into the future, which is over 2 rotations of ginseng. This was done is to get a better understanding of the long-term potential of ginseng as a crop.

5.1 BREAKEVEN ANALYSIS

The breakeven cost of ginseng is the price that ginseng must be sold at for the business to have equal benefits and costs. The analysis uses all the parameters presented in Table 1, with the exception of the price of ginseng. Figure 5 shows the breakeven price of ginseng per pound at 15 years and at 25 years.

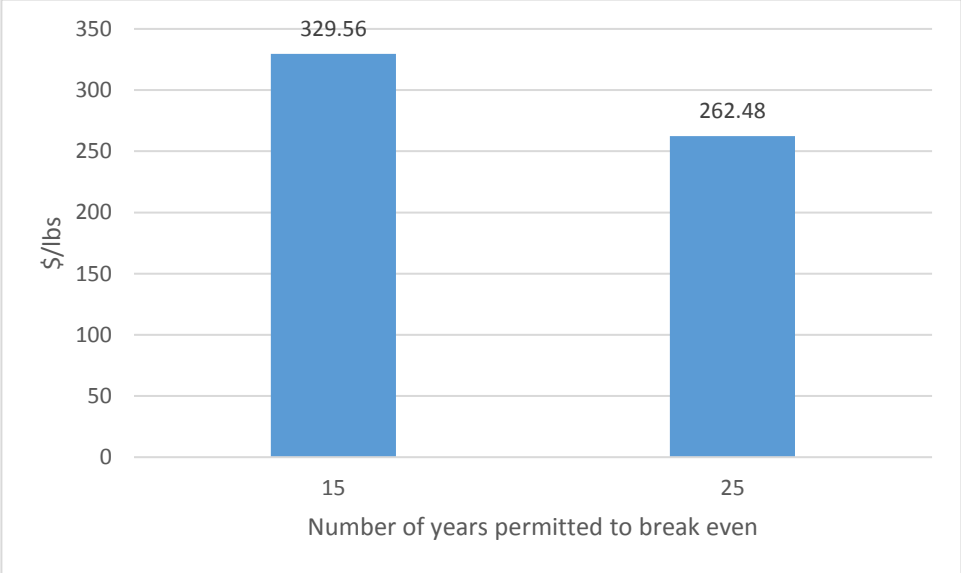

Figure 5: Minimum price required ($/lbs) to break even after 15 years and 25 years for a wild simulated ginseng growing operation.

The breakeven cost at 15 years is $329.56/lbs but this gets reduced to $262.48/lbs at 25 years. This scenario assumed ginseng would be planted right up until years 15 or 25 instead of years 6 or 16, which would be the minimum number of years planted to ensure harvest at years 15 or 25. This analysis also includes the requirement to build a fence, which may not be necessary. Most sources quote wild and wild-simulated ginseng in recent years at upwards of $500/lbs (USD), so it would appear that this business would break even before 15 years (Davis and Persons 2014).

5.2 INTERNAL RATE OF RETURN

The internal rate of return (IRR) is the projected rate of return of a project without considering discounting. A higher IRR is usually more desirable for a business. Figure 6 below shows the IRR of the study for 15 years and for 25 years. Keep in mind that under all possible circumstances, the IRR must be negative for the first 8 years.

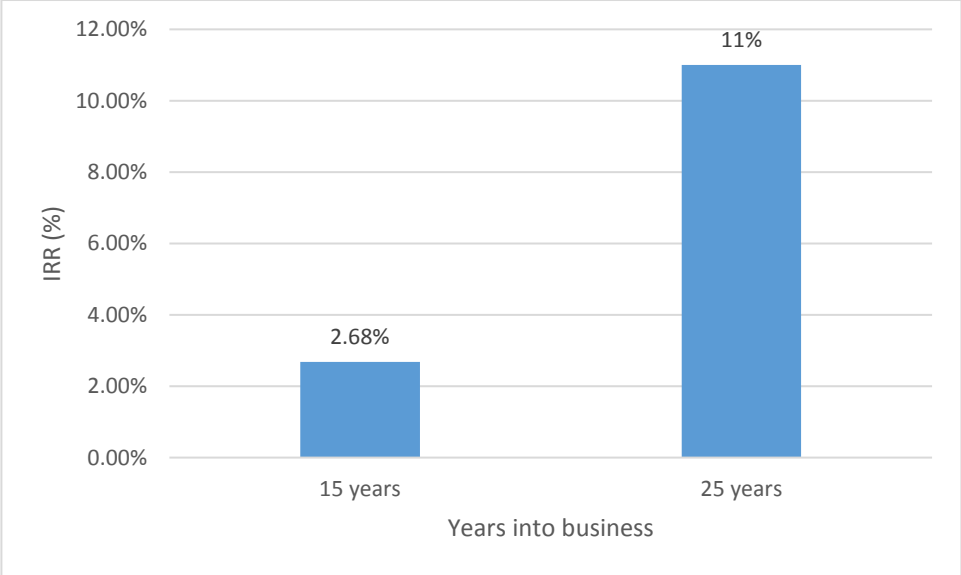

Figure 6: Internal rate of return (IRR) for the study at 15 years and at 25 years.

Figure 6 shows that the IRR is quite low after 15 years at only 2.68%; but it quadruples between years 15 and 25, to 11%. Like the breakeven analysis, ginseng was planted right up to years 15 or 25 (for future harvest) instead of years 6 or 16, which is the minimum amount of planting required.

5.3 NET PRESENT VALUE

The net present value (NPV) gives the value of gains in the future in present dollars, meaning it is accounting for the discounting of revenue over time. The NPV was calculated with using the parameters presented in Table 1, with a 6% discount rate. Figure 7 below presents the NPV at 16 years and at 25 years.

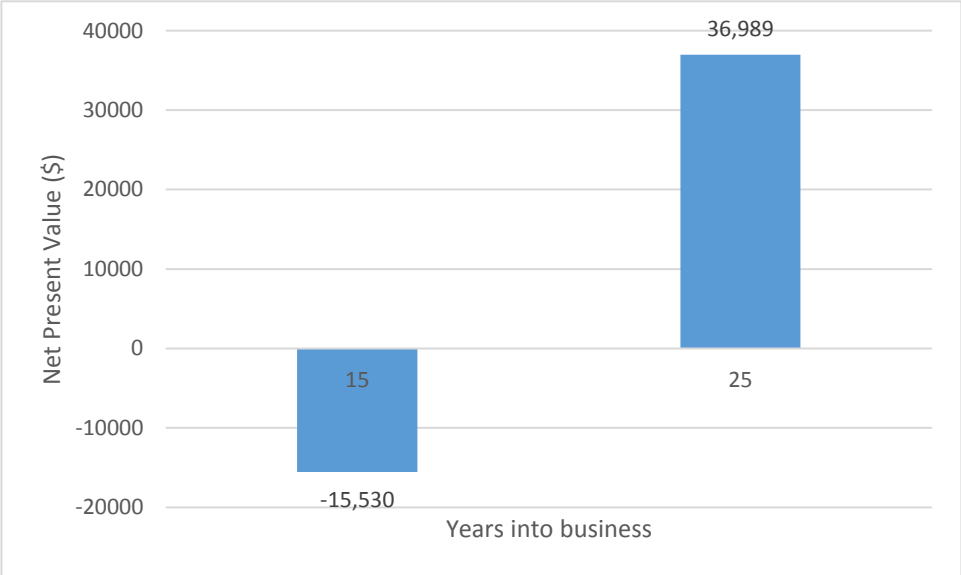

Figure 7: Net present value (NPV) of the case study at 15 years and 25 years.

Figure 7 shows that the NPV is negative at 15 years, but positive at 25 years. When one considers that the first 8 years result in no profit whatsoever, this should not

be a surprise. However, if the discount rate were 2.68% (the IRR at 15 years), the NPV would be $0 at 15 years.

5.4 BENEFIT – COST RATIO

The benefit – cost ratio (BCR) is calculated by dividing the present value of revenues by the present value of expenses. The resulting ratio gives an idea of what return on investment one can expect. For example, a BCR of 1.5 would mean that for every dollar invested, one can expect $1.50 in return. The BCR below in figure 8 was calculated using the assumptions listed in Table 1.

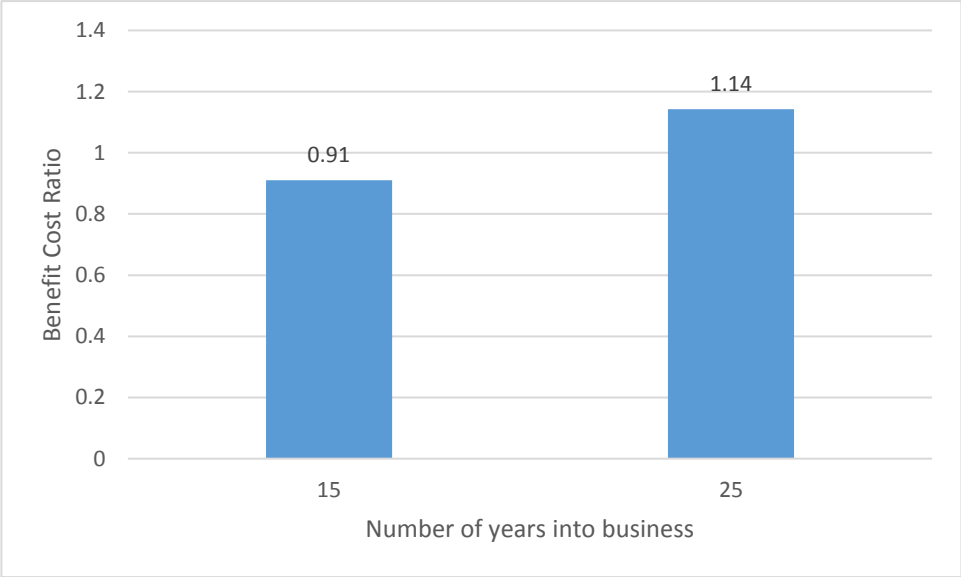

Figure 8: Benefit - cost ratio of the case study 15 years and 25 years after the initiation of the plan.

The BCR reflects what is show in Figure 3 (NPV). After 15 years, there is still a negative return on investment, but at 25 years it becomes positive, with every dollar invested returning $1.14.

5.5 PROFIT

Profit is the revenue minus cost for a business. Since ginseng takes 9 years before it can be harvested, it does not yield a profit for the first 8 years; but starting in the 9th year it would potentially become profitable. Figure 9 shows the annual profit in present and future dollars. It was calculated using the parameters presented in Table 1, and includes paying the cost of labour.

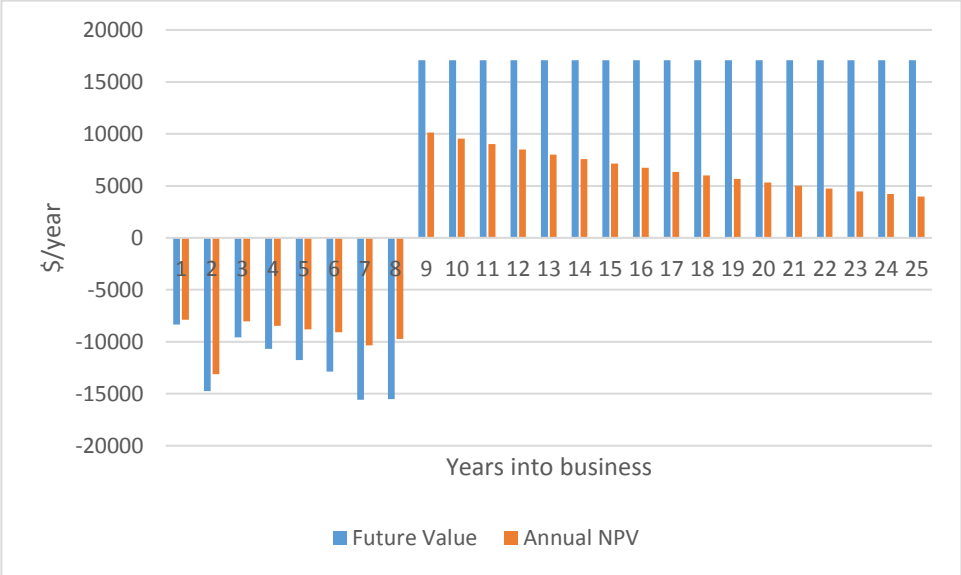

Figure 9. Profit per year including future value and net present value.

Figure 9 shows the significant effect discounting has on future profits. At year 9 and beyond, the annual profit in future dollars is $17 120.96; but once discounted, profit is $10 133.87 at year 9 and then steadily decreases. If labour costs were set to $0 (assuming the business owner did all the work), the profit jumps to $40 420.96, or $23 925.10 with discounting in year 9.

5.6 SENSITIVITY ANALYSIS

A sensitivity analysis was performed to determine how sensitive the outputs of a model are to changing inputs. For this scenario, the discount rates were changed to 3% and to 9%, at 15 years and at 25 years, to determine the effect these uncertain parameters might have on the net present value and benefit – cost ratio. Tables 2 and 3 show the expected NPV and BCR at 3%, 6% and 9% discount rates for 15 years and 25 years after the first ginseng crop was planted.

Table 2: Sensitivity analysis at 15 years.

	Discount Rate		
	3%	6%	9%
NPV	-1 953	-15 530	-23 436
BCR	0.99	0.91	0.83

Table 3: Sensitivity analysis at 25 years.

	Discount Rate		
	3%	6%	9%
NPV	91 678	36 989	6 695
BCR	1.24	1.14	1.04

6.0 DISCUSSION

In this section, the results will be analyzed, and the implications of these results for woodlot owners in southern Ontario will be discussed. This case study will also be compared to a similar one done in New Zealand. Possible risks, such as deer, poaching and disease and mitigation strategies for these threats will be explored.

6.1 IMPLICATIONS FOR SOUTHERN ONTARIO WOODLOT OWNERS

The results show that, even when conservative assumptions are used, ginseng can still be a valuable woodland crop, but only in the long term. Since the production of wild-simulated ginseng is not intensive, it will not lead to soil exhaustion, or replant disease that occurs when ginseng is grown intensively. Table 2 shows that even at low discount rates, ginseng still has a negative net present value at 15 years, but at 25 years ginseng has a positive net present value, even at the higher 9% discount rate. While 25 years is a significant period of time, relative to other forest products (trees), it is short. In fact, a 1981 economic analysis if different silvicultural treatments in Canada found that many forestry activities have a negative net present value and a benefit-cost ratio below 1, indicating that the discount rates are too significant for the initial investments in silviculture to be recouped (Fraser 1985). Ginseng has the potential to allow woodlot owners to have a shorter return on investment than tree crops. This would be especially useful for degraded woodlots that are unable to yield commercially saleable lumber for 1 or 2 cutting cycles until stand improvement cuts have been allowed to take effect.

It is estimated that sugar maple makes up 4% of the forest volume of Ontario (OMNR 2018). If we assume this means it is 4% of the area of a productive forest, sugar maple would cover more than 2 million hectares. Of course a significant portion of this is outside of the natural range of ginseng, as ginseng does not extend as far north as sugar maple, but if even only 5% (a very conservative estimate) of sugar maple stands were found within the natural range of ginseng, this represents about 112 000 hectares. If we assume 10% of that area is located on private lands, 11 200 hectares (24 640 acres) are available for growing ginseng. Using the assumptions presented in Table 1, and applying them to the entire 24 640 acres, an annual gross profit of $123 200 000 can be realized, or a net profit of $46 873 384. In contrast, the total farm value of maple syrup production for Ontario in 2017 was $24 947 000 (OMAFRA 2018). Ginseng has the potential to increase the value of woodlots in Ontario substantially and provide a good incentive for landowners to manage their woodlots well.

6.2 NEW ZEALAND CASE STUDY

New Zealand has recently experimented with growing both American and Asian ginseng under the canopy of radiata pine (*Pinus radiata* D.Don.) plantations on the North Island (Ministry of Primary Industries 2017). In fact, yields are such that one hectare of land that can grow pine and ginseng simultaneously is valued at $400 000 NZD (MPI 2017). This more than doubles the value of radiata pine plantations. Assumptions for labour were very similar to those used here, with approximately 1000 man hours dedicated to each 0.33 hectare (0.81 acres) (Yao et al 2013). Most labour is required during the harvesting of ginseng, which could provide significant employment for local workers. In fact, 1000 hectares planted each year for the next ten years is

projected to increase the annual GDP of New Zealand by 0.2%, or $313 million (Schilling et al 2013). Since it is using the wild-simulated method of growing ginseng, soil exhaustion and replant disease are not seen as issues.

The profit numbers from the New Zealand study are much higher since they assume a higher sale price of ginseng, no deer fence, and a somewhat higher yield (MPI 2017). New Zealand also has a somewhat closer proximity to the Asian market, but this likely had little effect on the numbers. Bob Beyfuss states that high-end buyers prefer ginseng that is grown in its natural habitat, and New Zealand is not the natural habitat of any ginseng species (pers. Comm., January 12, 2018). Nevertheless, wild-simulated ginseng from New Zealand still sells at high prices compared to other types of ginseng (Schilling et al 2013).

6.3 RISKS AND POSSIBLE MITIGATION STRATEGIES

There are substantial human and natural risks associated with growing ginseng such as deer, poaching, disease and rodents. The level of risk will be assessed and possible mitigation strategies discussed.

Deer are of high concern, and some scientists forecast that wild ginseng populations may be extirpated from large parts of North America in the next 100 years because of deer browsing (McGraw et al 2005). Deer numbers are now much higher than has been normal in the past because they adapted very well to human-created landscapes (farms), and ginseng is poorly adapted to intensive browsing. Possible strategies for mitigating deer damage include physical barriers (fencing), hunting and scent barriers, such as spraying garlic extract on plants (Davis and Persons 2014).

Physical barriers can be expensive to build and time consuming to maintain, but are generally quite effective for preventing deer from browsing desirable plants. In contrast, chemical or scent barriers must be reapplied frequently (after every rainfall), and deer can become habituated to them (Davis and Persons 2014). Hunting can be a viable option in some jurisdictions, but in Ontario it can be difficult to obtain these permits, even when it is to control deer on private land (OMNR 2017). A physical deer barrier was chosen in the methods section because it guarantees security from deer and it is simple to quantify the cost of building such a fence. It may not be the most cost effective solution, but the outcome can be guaranteed.

Poaching refers to the unauthorized act of harvesting ginseng from private or public land. Note that ginseng is the only plant species that is 'hunted' and 'poached'. This is in part because it has a very high value compared to its size, and often gets nicknamed 'green gold' by ginseng diggers (Pritts 2010). Ginseng digging is an ingrained part of the Appalachian culture in the United States, where families would typically head for the hills to gather ginseng when they were unemployed (Pritts 2010). For this reason, ginseng poaching is considered much more of an issue in Appalachia than any other part of its range. In fact, extension agents in West Virginia do not recommend landowners grow ginseng, as poaching is rampant and private land is often not respected (Davis and Persons 2014). Outside of Appalachia, ginseng poaching still occurs but is generally not considered a major issue if ginseng growers remain discreet about their operation (Persons 1994). Daily monitoring of ginseng will also troubleshoot any issues with poaching. Since digging ginseng is a slow and delicate process, it can take a long time before detrimental amounts can be poached, especially in the dark (Persons 1994). All authorities on growing ginseng note that the use of loaded firearms to prevent poaching is not only illegal, but it has resulted in jail time for overzealous landowners.

Fungal diseases are also a constant source of worry for ginseng growers. Diseases such as *Alternaria panax* and *Phytophthora cactorum* have caused large losses for ginseng growers, particularly those engaging in the field cultivation of ginseng (Mudge et al 2014). Possible mitigation strategies include regular monitoring and removal of infected plants, selection of disease-free seed sources, and the application of fungicides (Davis and Persons 2014). The latter must be done quite frequently once an infection is found amongst cultivated ginseng. There are consumers who would also prefer that ginseng not be sprayed with fungicides, which means this is not an option if organic ginseng is to be grown. Davis and Persons agree that growing wild-simulated ginseng without the use of fungicides is quite possible, but it requires vigilance to ensure that ginseng plants who exhibit fungal infections be gathered and destroyed on a regular basis. This approach is not possible with field-cultivated ginseng, and must be practiced very rigorously with woods cultivated ginseng (Davis and Persons 2014).

Rodents are an unpredictable factor in the cultivation of ginseng. Often growers can go decades without any issues, only to have a sudden influx of rodents eat most of their ginseng roots while they are still in the ground (Mudge et al 2014). While there are rodenticides labelled for use on ginseng in the United States, this method can lead to the death of species other than just rodents, namely the predators of the rodents. Many ginseng growers recommend growers support the predators of rodents, such as owls, by installing next boxes close to ginseng patches (Davis and Persons 2014). Traps can also be used, albeit less successfully during the winter season. Rodents can also collect the seeds before they are gathered by humans for stratification, which presents another challenge. It is not recommended that ginseng berries be picked while unripe, since the viability of the seeds is decreased, but they must be picked just as they are getting ripe in order to ensure that as much can be harvested as possible before the rodents do (Pritts 2010).

6.4 LIMITATIONS

This study has some notable limitations, not the least of which is the unknown ability of ginseng to grow on the study location described in the methods. While many indicator plants are present on the site, this is no guarantee that American ginseng would be able to survive or thrive in the location used in the business model. It is simply an assumption that was made based on a review of the literature.

The labour statistics, while derived from reputable sources, may not reflect the realities present in the location of study. The same can be said for yield data, which is once again based on a review of the literature, instead of evidence from the study location. In order to form an accurate estimate of the viability of a ginseng growing operation in a sugarbush in southern Ontario, one has to grow, tend, harvest and market several crops of ginseng while keeping track of all capital and labour inputs. This was not feasible given the time restrictions of this study, and because of the uncertain legal status of wild-simulated ginseng at this time, but it should be looked at in the future. The New Zealand case study presented in section 6.2, and wild-simulated ginseng growing businesses in the United States could be more thoroughly examined to see how well their business models work.

7.0 CONCLUSION

The cultivation of wild-simulated American ginseng, though currently not practiced in Ontario, represents a good opportunity to provide income to landowners, thereby conserving valuable forests on private land in southern Ontario. It requires little capital inputs aside from land, and can be incorporated into many existing farm or forestry operations. Since the labour required is concentrated in the fall, a ginseng growing operation does not conflict with a sugar bush operation, which can occupy the same pieces of land.

In order to promote the cultivation of wild-simulated ginseng in Ontario, a legal uncertainties surrounding the cultivation of ginseng should be clarified. While scientists are concerned that the cultivation of wild-simulated ginseng can spread diseases to wild populations, the blanket prohibition on this practice may in fact be doing greater damage to wild ginseng by not allowing a substitution of supply. By eliminating the supply of wild-simulated roots in Ontario, consumers who prefer these roots wild continue to poach wild populations. By allowing growers to fulfill this market demand, the pressure on wild ginseng populations can be reduced. This vision is shared by many, notably the United Plant Savers, an organization that encourages *conservation through cultivation*. This is also the opinion of Mr. Bob Beyfuss, one of the foremost authorities on American ginseng in the world.

There are some legitimate concerns regarding wild ginseng that should be addressed. Currently, the export of wild ginseng is prohibited under Convention on International Trade in Endangered Species (CITES) rules. Wild-simulated ginseng, which is virtually indistinguishable from wild ginseng, would be difficult to get across an international border without raising eyebrows. Organizations, such as the United

Plant Savers, are proposing a system of third-party certification which would verify which wild-simulated ginseng was produced in a sustainable manner.

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9.0 APPENDIX

9.1 BUILDOUT INFRASTRUCTURE

Items	# of units	$/unit	Total Cost	Description
Drying Kiln				
Spade to dig post holes for drying shed	1	12.99	12.99	
Cedar poles	4	15	60	9' cedar poles
Wire mesh roll	1	19.99	19.99	For drying racks, 4'wide
2x4x8 for wire rack assembly	20	3.14	62.8	For drying racks as well as drying rack supports, roof rafters (shanty style), as well as siding attachments
8' corrugated galvanized steel roof panel	1	11.97	11.97	For roof
Screws (box) #10 x 3 inch Philips exterior	1	7.43	7.43	For assembly of structure
Siding (96 ft2) plus door material	37	7.72	285.64	Pine board siding
Dehumidifier	1	119.99	119.99	Drying the ginseng in the shed
Extension cord	1	106	106	100' to get electricity to shed
Philips screwdriver	1	6.99	6.99	For assembly of structure
Fuel for picking up materials	8	1.1	8.8	
Subtotal			702.6	
Sales Tax (13%)			91.338	
Fencing				
700 m of electric fencing (6 strands)	4200	0.5	2100	The expected perimeter of the fence is 700 m, so a 6 stranded, 7' high electric fence would require 4200 m of wire
Electric fencer	1	235.15	235.15	

Fence Posts (cut from farm)	100	0	0
Insulators	600	0.2	120
Gates	2	125.99	251.98
Subtotal			2707.13
Sales Tax (13%)			351.93
Total Infrastructure Cost ($)			**3852.99**

9.2 BUILDOUT LABOUR

Item	**# of persons**	**Hours/person**	**# of hours**	**Cost/hour**	**Total cost**
Drying Shed					
Driving to town to pick up equipment and material	1	1	1	20	20
Picking up equipment	1	1	1	20	20
Digging 4 post holes and installing posts	1	2	2	20	40
Installing siding	2	1	2	20	40
Installing roof	2	1	2	20	40
Building drying racks	1	1	1	20	20
Installing drying racks	1	1	1	20	20
Subtotal					200
Fencing					
Driving to town to pick up equipment and material	1	1	1	20	20
Picking up equipment	1	1	1	20	20
Clearing fence right of way	2	25	50	20	1000
Digging 100 post holes and installing posts	1	50	50	20	1000
Installing insulators	1	5	5	20	100
Installing wire	2	25	50	20	1000
Installing gates	2	2	4	20	80

Subtotal	3220
Total Labour Cost ($)	**3420**

9.3 EQUIPMENT (NOT ALREADY LISTED)

Item	**# of units**	**Cost/unit**	**Total Cost**
Chainsaw (Stihl MS 261)	1	699.96	699.96
Sharp-nosed spades	2	12.99	25.98
Flathead screwdriver	2	6.99	13.98
Wheel barrow	1	99.99	99.99
Leaf rake	1	17.98	17.98
Subtotal			857.89
Sales Tax (13%)			111.53
Total Equipment Cost ($)			**969.42**